

**2014 Population Monitoring for *Arenaria cumberlandensis* (*Minuartia cumberlandensis*), Cumberland Sandwort,
For the Tier 1 Sites**



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INTRODUCTION

Arenaria cumberlandensis or *Minuartia cumberlandensis* (Cumberland sandwort) is endemic to the Cumberland Plateau sandstone rockhouses of northeastern Tennessee and southeastern Kentucky. It was listed by the U.S. Fish and Wildlife Service as an endangered species in 1988 and is currently listed as state endangered in Tennessee and Kentucky. In 2000, a monitoring protocol was established by the Tennessee Division of Natural Areas (DNA) and baseline monitoring was conducted at 33 sites in Tennessee (Bailey and Shea 2000). Monitoring data is necessary for assessing recovery goals and determining threats to the populations of *Arenaria cumberlandensis*. The sites have been divided into three monitoring priority rankings based on threats, location, ownership status (public and private) and accessibility; Tier 1 will be monitored every 1-3 years, Tier 2 monitored every 3-6 years, and Tier 3 monitored every 6-10 years. In 2014, 18 element occurrences totaling 24 Tier 1 sites were monitored. In this report, the information relative to sections of the USFWS 5- Year Review assessment are noted with corresponding section heading numbers; i.e. 2.3.1 Biology and Habitat.

Habitat

Cumberland sandwort habitat is restricted to the shaded, moist rockhouses found along the Cumberland Plateau escarpment within the Big South Fork River watershed. More specifically, the habitat is under the sandstone overhangs in the shaded, moist sand (rockhouses), solution pockets, and fissures in sandstone bluffs and cliffs. The floor of the rockhouses can receive little or no direct sunlight at any part of the day anytime of the year. The Cumberland sandwort is found in four counties in Tennessee (Fentress, Morgan, Pickett, and Scott) and one county in Kentucky (McCreary).

Concentrations of the plants can be found in Pickett State Park and State Forest (PSP/SF), and in the western sections of the Big South Fork National River and Recreation Area (BSF). However, any rockhouse habitat within the Big South Fork River watershed on public or private land could be considered potential habitat. At the time of federal listing, *Arenaria cumberlandensis* was known only from five occurrences, one in Kentucky and four in Tennessee. At present, 66 occurrences in Tennessee and one extant occurrence in Kentucky have been documented, with the majority located on public lands in Tennessee. (2.3.1)

MONITORING

Monitoring Protocol

During the 2000 survey, it was determined that typical monitoring of the populations to determine numbers of individuals at a site could possibly be harmful to the plants. The habitat and the plants are very fragile and cannot withstand any trampling. The soils in rockhouses are very sandy, rocky and shallow so permanent markers and plots would be difficult to establish. Also in the winter, the floors of the rockhouses at the drip line are wet and the freeze/thaw dynamics disturb the substrate. Counting the *Arenaria* without standing right on top of them is almost impossible because the plants are so small and some occur on high ledges. It is not very accurate to monitor from a distance even with binoculars. It was determined that the most feasible monitoring method was to estimate the size of the area occupied by the plants.

During the 2006-2007 monitoring period, the area occupied by *Arenaria* was estimated by meter square and the general number of plants at each site was estimated. Photographs were taken and the existing site drawings were updated. Some of the sites are very remote and are difficult to access and may not be visited for several years. The sites that are on trails and can be easily accessed by hikers have the greatest

threats and need to be monitored more frequently (Tier 1). In total, there are 80 monitoring sites, 70 are on public lands and 10 are on private lands.

All of the Tier 1 sites are located on public land in Pickett State Park and Forest, BSFRRRA and Pogue Creek State Natural Area. The majority of the Tier 1 sites are rockhouses with designated hiking trails going through or adjacent to them. Fourteen of the 24 sites have immediate threats to the sandwort population including trampling, camp fires, and relic digging mostly because of the easy accessibility. Other threats that were noted in 2014 included natural processes like competition from mosses and liverworts and coyote denning. Most other sites have potential threats that include trampling and relic digging as well as natural processes. The monitoring data from 2006-2007 were presented in the 2007 monitoring report (TDEC 2007). In 2009, EO 30, a Tier 1 site on the Middle Creek loop trail, was deleted and merged with EO 61, a Tier 2 site. There are now two rockhouses, EO 61(1), a Tier 2 site, and EO 61(2) a Tier 1 site. In 2014, 24 Tier 1 sites were monitored by DNA on public lands (Table 1). In 2014, DNA staff worked with AmeriCorps volunteers to merge the two segments of existing fencing at Hazard Cave to promote the expansion of the *A. cumberlandensis* population at this site. (2.3.2)

Monitoring Results

Repeating the estimation of cover of *A. cumberlandensis* proved to be a bit of a challenge given subjective differences by who was conducting the survey. It appears that since the plants are scattered over a large area, it is difficult to estimate cover, and sometimes even more difficult to estimate number of plants when populations are very dense. While these decreases or increases are subject to human error, notes on natural or anthropogenic threats were noted. During the monitoring period, if a change has taken place in the disturbance or in the growth pattern then it will be noted and will be considered relevant.

Overall in 2014, 11 sites showed a decrease in population size over the three years of monitoring. Notes on these sites indicate that threats such as trampling, equestrian use and natural processes are likely contributing to these declines. Four sites showed a slight decrease, 3 sites remained the same over last monitoring period, and 6 sites increased. Total area covered has declined from 347m² recorded in 2006-07 to 223.95m² in 2014. It should be emphasized that the subjectivity in monitoring should be considered when examining these results. Despite the subjectivity in monitoring, many sites have shown continued decreases in all three years of monitoring. (Table 2). (2.3.1.2)

Although formal monitoring of *Arenaria cumberlandensis* only began in 2006, efforts to protect the species have been ongoing since the 1990's. Since then, a total of eight Tier 1 sites have undergone management to deter trampling. However, because formal monitoring of this species has only been ongoing since 2006, there is no previous data to measure the direct effects of these efforts. Despite that, of these eight sites, four have increased in total area occupied by *Arenaria cumberlandensis* since 2006. Four other sites have continued to record declines. From the field notes, it seems apparent that these declines are due to fences needing repair, trampling deterrents not aggressive enough or, in one case, equestrian impacts from off-trail riding. It seems as if the fencing is the most successful option for deterring trampling at the Tier 1 sites. A summary of these findings and the 2014 field observations are below in Table 1. (2.3.2)

In addition to anthropogenic disturbances at Tier 1 sites, other disturbances noted were natural. At one site (Middle Creek (61-1)), a coyote pack had utilized the rockhouse and very few plants were observed at this site in 2014, likely due to trampling. Changes in light availability and humidity from treefall also continue to affect this species at some sites. It was casually observed that some terrestrial mosses and liverworts were successful in areas where *A. cumberlandensis* had once occupied. The extent and impact, as well as the drivers of this threat are unknown. (2.3.1.6) (2.3.2)

Table 1 Summary of monitoring data and percent change for eight Tier 1 *Arenaria cumberlandensis* sites that have received some type of protective management beginning in 1990.

Site Name	Site Num	2006	2011	2014	%Change	Management Completed	Notes
Hazard Cave	4A	25	30	50.75	103%	1990: fencing 2002: fencing improved 2014: fencing connected	Still some trampling. Fencing was finally connected in 2014.
Hidden Passage (1)	11-1	16	15	8	-50%	2008: cribbing and signs installed	Some trampling where people have cut off the trail.
Hidden Passage(2)	11-2	17.5	16.5	22.5	29%	2008: cribbing and signs installed	Trampling and scraping of sand.
Ladder Trail	13	14	40	44	214%	2008: cribbing and signs installed	Trail cribbing seems to be helping. Some <i>Arenaria</i> even established on the inside of the cribbing where people are less likely to step close to the cribbing.
Hippy Cave	60-2	40	36.5	18.5	-54%	2004: fencing	Equestrian and human trampling observed.
Middle Creek	61-1	1	0.6	5	400%	2003: fencing	Looks like a coyote pack took residence here. Likely this area represents a much less dense representation than in the past.
Crystal Falls	5	3	2.75	1	-67%	2008: signs installed	Trampling and climbing on rocks has done some damage.
Indian Rockhouse	24	7.5	6	5	-33%	2000: fencing 2003 and 2008: signs installed	Trampling and the fence needs repair.

Additionally in 2014, Megan Philpott, a Masters student at University of Cincinnati conducting genetic research on the in vitro population introduced to a rockhouse in Daniel Boone National Forest (DBNF) in Kentucky, presented her research at the Natural Areas Conference in Dayton, Ohio. In 2005, 63 plants derived via micropropagation at Cincinnati Zoo & botanical Garden's Center for Conservation & Research of Endangered Wildlife (CREW) were planted. These 63 individuals represented 7 genetic lines. When this population was monitored in 2013, a total of 150 reproductive individuals were recorded. The source for these 63 individuals originally came from Hazard Cave in Pickett State Forest. She compared results from 30 sampled individuals from both the source site (Hazard Cave) and the introduced site (DBNF). Preliminary results show that genetic diversity at DBNF has reached similar levels to that of the source site (Philpott 2014). The implications of this result are that reintroduction of this species to

previously unoccupied rock houses has proven to be successful and is a feasible option to meet recovery requirements for this species. (2.3.1.3)

Philpott contacted DNA in 2014 showing interest in pursuing other genetic questions with this species for her doctorate. We suggested that she may be able to compare genetic diversity between Tier 1 sites and Tier 3 sites to determine if any bottlenecking effects have occurred due to high levels of disturbance.

CONCLUSIONS

The subjectivity of estimating cover as a monitoring method has made quantifying populations difficult. Comparisons of notes on threats and hand-drawn maps that give us an idea of spatial changes are useful for determining declines, stability or increases in populations. At sites with low percent area covered, small changes in area covered have more amplified consequences, but the human error in subjectivity may dilute or disguise these changes. Large populations may be more difficult to estimate and staff from year-to-year may have greatly varying ideas of area covered, possibly falsely indicating large declines or increases in population. To mitigate the subjectivity in monitoring *A. cumberlandensis*, a class value system might be considered. This way, subjectivity is minimized and a scoring matrix can be developed for recognizing relevant changes in the health of each rock house. In addition, taking a panoramic photo of the rock house at each site would also provide a better spatial sense for movement or changes in density at each rock house.

It does appear that efforts to protect *A. cumberlandensis* have been successful at 50% of the sites where some management has occurred. Despite the subjectivity in the monitoring methods, field notes combined with estimates of percent cover seem to illustrate an overall decline in overall population at Tier 1 sites, with a 67% decrease and 33% increase in estimated area of *Arenaria* cover. Data and field notes on threats from 2006 to 2014 are included in the Appendix.

REFERENCES

Bailey, Claude and Andrea Shea. 2000. New Population Survey, Site Protection Survey, and Monitoring Protocol for *Arenaria cumberlandensis*. Division of Natural Heritage, Report for U.S. Fish and Wildlife Service, Atlanta GA, Section 6, Segment 14.

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Appendix

Table 2. Tier 1 *Arenaria cumberlandensis* monitoring estimates from 2006 to 2014.

EOR	Owner/Site Name	Measure	2014	2011	2006/7	status	Immediate Threats (2014)	Potential Threats (2014)
1a	NPS/Big Island	Est# Plants	550		250-500			Digging in recent past, fire pits observed in past. Deer trails
		Area Cover m ²	3.5	3	0.5	+		
1b	NPS/Big Island	Est# Plants	3000		2100+			
		Area Cover m ²	5.5	11		-		
1c	NPS/Big Island	Est# Plants	150					
		Area Cover m ²	1.0			+		
3	NPS/Peters Bridge	Est# Plants	24		127			No recent signs of disturbance, is drier than other sites.
		Area Cover m ²	0.5	0.5		-		
4	TSP/Hazard Cave	Est# Plants			3150		Trampling	digging, vegetation competition
		Area Cover m ²	50.7 5	30	25+	+		
5	TSP/Crystal Falls	Est# Plants	20		300-500		Trampling and climbing on rocks has done significant damage.	south facing slope
		Area Cover m ²	1	2.75	3	-		
11(1)	TDF/Hidden Passage Waterfall	Est# Plants	300		1500		Some trampling where hikers have cut off the trail.	
		Area Cover m ²	8	15	16	-		
11(2)	TDF/Hidden Passage Waterfall	Est# Plants			1500		Trampling and scraping of sand.	
		Area Cover m ²	22.5	16.5	17.5	+		
13	TSP/Ladder Trail	Est# Plants	4000		4150		Trail cribbing is helping.	

EOR	Owner/Site Name	Measure	2014	2011	2006/7	status	Immediate Threats (2014)	Potential Threats (2014)
			+					
		Area Cover m ²	44	40	41	+		
17	NPS/Slave Falls	Est# Plants		1000 +	3200		Needs Arenaria sign. Walking behind fence.	Trampling, natural erosion.
		Area Cover m ²	13.7 5	25	60	-		
24	TDF/Indian Rockhouse	Est# Plants			1000+		Trampling, fence needs repair	
		Area Cover m ²	5	6	7.5	-		
26	TSP/Natural Arch Bridge (lake)	Est# Plants	50		70- 100			Disturbance from off trail hiking. More open and drier than other sites
		Area Cover m ²	0.5	2	1	-		
27	NPS/Middle Creek Loop Trail	Est# Plants		50- 100	62		Fire pit, hog and people trampling.	South facing slope-dry
		Area Cover m ²	0.5	0.75	1	-		
29(1)	NPS/Middle Creek Loop Trail	Est# Plants			95			Ledge accessible
		Area Cover m ²	1	0.25	0.5	+		
29 (2)(3)	NPS/Middle Creek Loop Trail	Est# Plants			1000+			Looks like a liverwort and some moss outcompeting Arenaria here. West facing slope. Sand very saturated here and lots of tannin in the water.
		Area Cover m ²	5	14.5	35	-		
31	NPS/Middle Creek Loop Trail	Est# Plants		500	500- 1000			
		Area Cover m ²	5	3	5	+		
42	NPS/Twin Arches Loop Trail	Est# Plants			500- 1000			Trampling
		Area Cover	5	3.5	3.5	+		

EOR	Owner/Site Name	Measure	2014	2011	2006/7	status	Immediate Threats (2014)	Potential Threats (2014)
		m ²						
45	NPS/Twin Arches Loop Trail (stairs)	Est# Plants	100+	100s	532+		Trampling	
		Area Cover m ²	1	4.3	2	-		
47	NPS/Slave Falls (downstream)	Est# Plants	300		800		Rock stacking and trampling.	Digging in past. Fire pit in past
		Area Cover m ²	4	4.5	7.5	-		
60(1)	NPS/Hippy Cave	Est# Plants	1000+		6130		Equestrian and human trampling severe	
		Area Cover m ²	18.5	36.5	40	-		
60(2)	NPS/Below Hippy Cave	Est# Plants	1000+		2,250		Trampling	Digging. Moss seems to be outcompeting Arenaria.
		Area Cover m ²	9.5	19	30	-		
61(1)	NPS/Middle Creek Loop Trail	Est# Plants	10		250		Possible coyote pack has used this for a den. Significant trampling and canine tracks.	
		Area Cover m ²	0.5	0.6	1	-		
61(2)	NPS/Middle Creek Loop Trail	Est# Plants	1000+		1000		.	
		Area Cover m ²	8.2	10-20	20	-		
65	NPS/Laurel Fork - Darrow Ridge Rd.	Est# Plants			1760		Past digging operation, but may have been more recent.	Digging. Also was unable to see one of the ledges, so may be a low estimate.
		Area Cover m ²	5.25	36	30	-		
	Total Increase					67%		
	Total Decrease					33%		